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REPORT NO. 79-4

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Environmental Factors in the Onset of Illness Aboard Navy Ships *

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Report Number 79-4

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Environmental Factors in the Onset of

Illness Aboard Navy Ships

Recent epidemiological studies of illness among the crews of six large U.S. Navy ships revealed differences in illness rates related to personnel composition and job characteristics; for example, occupation and job experience (Gunderson, Rahe, & Arthur, 1970; Rahe, Gunderson, Pugh, Rubin, & Arthur, 1972). In addition, McDonald, Pugh, and Gunderson (1973) reported large differences in illness rates between ships which were not explained by differences in personnel or job characteristics. The authors proposed that organizational and social factors might account for a portion of this large unexplained variance in morbidity rates. A large-scale investigation was then launched to determine the contributions of physical environment, personnel characteristics, and organizational or social qualities of the work environment to the prediction of illness rates aboard Navy ships. The objective was to develop a morbidity forecast model which ultimately could be applied to the identification of environments which are high health risk situations (Gunderson & Sells, Note 1).

The purpose of the present study then was to predict illness rates within shipboard environments from physical characteristics of the environment, personnel composition, and organizational or social factors. Before this objective could be pursued, it was necessary to define the environment in terms of specific variables and to identify the proper approach to environ-

mental measurement and analysis aboard ship. This task was carried out in a series of pilot studies involving 13 ships and approximately 1,000 men (James & Hornick, Note 2).

Investigators who have dealt with the problem of environmental assessment agree that spatial characteristics alone are not sufficient to define an environment (Insel & Moos, 1974; Ittleson, 1973; Moos, 1973; Pugh, 1977). Barker and his associates (Barker, 1968; Barker & Gump, 1964) suggested that the relevant environment for human behavior can be defined by a combination of physical or spatial features and typical behavior patterns. In other words, in order to describe an environment meaningfully one must indicate how it is used by the inhabitants. Barker called such an environmental unit a "behavior setting." An example would be a baseball field because it is defined by the physical layout of the bases, boundaries, etc., and by the specific behaviors that are expected to occur on the playing field during a game. Navy ships provide many examples of behavior settings because they are complete communities where specific kinds of behavior can be predicted in particular spaces or areas. In this study the work environments of the ship are considered the most important behavior settings for study, and the division appears to be the most appropriate organizational unit for analysis because members of a division not only share common work spaces and tasks but common sleeping, eating, and recreational spaces as well.

The problem of finding meaningful ways to conceptualize the environment and to identify features which discriminate among environments have been discussed by Sells and Gunderson (1972), Sells (1963), Moos (1973), Insel and

Moos (1974), and James and Jones (1976). These authors note that in addition to the physical and objective characteristics of environments, such as distinctive architectural features, there are organizational features that can be objectively specified, such as work group size, type of equipment used, nature of tasks, etc., which distinguish among work environments.

More difficult to assess and quantify than the physical environment is the social environment. This domain corresponds to the "personality" or "atmosphere" of the work environment. Instruments designed to measure characteristics of the social environment or organizational climate have been developed by Moos (1973) and Jones and James (in press). The former instrument assesses 10 environmental dimensions which Moos grouped into three broad areas: (a) relationship dimensions, including involvement and support; (b) personal development dimensions, including autonomy and personal problem orientation, and (c) system maintenance dimensions, such as clarity and control. This system has been used to describe a variety of environments but principally treatment or therapeutic environments.

The Jones and James instrument was used in the present study, and its development and characteristics have been described in a series of previous reports (James & Jones, 1974; Jones & James, in press). Briefly, six scales are used to characterize the work environment: (a) Conflict and Ambiguity; (b) Job Challenge, Importance, and Variety; (c) Leader Facilitation and Support; (d) Workgroup Cooperation, Friendliness, and Warmth; (e) Professional and Organizational Esprit, and (f) Job Standards.

In addition to the physical and social characteristics of an environment,

a third domain consists of individual attributes of those who work in it, such as age, ability or intelligence, and education. Values on such attributes can be averaged for a group to characterize the personnel composition of a work environment. A division of variables in this domain was proposed by Jones and James (in press) in terms of characteristics the individual brings into the organization, for example, age and intelligence, versus those that are jointly determined by the organization and the individual, that is, specific occupation and tenure. The former category was referred to as personnel resource variables and the latter as position variables.

By focusing on environmental factors in the onset of illness, the present study focuses primarily on where (in what work settings) illnesses occur rather than who (what kind of person) becomes ill. Specifically, illness rates for divisions were examined to identify high and low risk work environments and a variety of environmental characteristics of the division work settings were evaluated to assess their ability to discriminate high from low risk environments. If work environments with high rates of specific disorders can be identified and described, the etiologies of those disorders might be better understood and remedial or preventive action might be possible.

Method

Participants

Work environments were assessed by 3,057 Navy enlisted crew members aboard 18 destroyer-type ships during 6- to 8-month overseas deployments. The ship types included were: 3 destroyers, 6 guided missile destroyers, 3 frigates, and 6 destroyer escorts. Half of the ships were deployed to the

Atlantic and Mediterranean and half to the Pacific. The unit of analysis for the study was the division which ranged in size from approximately 15 to 80 men. The median division size was about 20 men. Approximately 70% of all crew members aboard the 18 ships participated in the study, and sufficient data were available from 188 divisions for inclusion in the major analyses.

Measurement of the Physical Environment

In preliminary studies divisions aboard ship were shown to differ considerably in characteristics of their work environments. Conditions ranged from carefully regulated and relatively comfortable work spaces occupied by highly technical divisions, such as communications and navigation, to extremely hot, noisy, dirty, and relatively unsafe work spaces occupied by engineering division personnel (Gunderson, 1978). In addition, tasks such as those performed by personnel from deck and engineering divisions demanded much more physical activity than tasks performed by personnel in other types of divisions. Thus, division type (e.g., deck, navigation, or repair) appeared to be a viable way to summarize salient physical aspects of division environments including the physical demands of the tasks required as well as the comfort and safety of the space and equipment used.

Measurement of the Social Environment

The social or organizational characteristics of the work environments aboard ship were assessed by a questionnaire developed by Jones and James (in press). The questionnaire was administered to crew members early in the ship's deployment, and individual scores were computed using a direct solution method (Harman, 1967) to score the six principal components derived by Jones and James.

Mean scores on each component were computed for divisions and were used as measures of the division work climate.

Personnel Composition.

The quality of personnel in a division is defined as the aggregate of the abilities/intelligence/education/training, job experience, and maturity of the individuals in the division. Thus, personnel composition refers to a combination of individual attributes which are (a) brought to the situation, that is, personnel resources variables, and (b) determined jointly by the individual and the organization, that is, position variables. The individual measures that were aggregated for each division to develop a measure of personnel composition were: (a) pay grade as a measure of abilities/intelligence; (b) years of formal education as a measure of education/training; (c) months of military service as a measure of job experience, and (d) age and marital status as a measure of maturity. These measures were combined into a single composite representing personnel quality by weighting each variable so that it would contribute approximately equally to the total score. The personnel composition score, then, was created by summing mean pay grade, mean years of education, mean months of service, mean age, and percent married after each variable had been assigned its respective weight (see Pugh & Jones, Note 3, for details of weighting procedures).

Illness Data

Illness and injury data were collected on all ships by recording individual dispensary visits on specially designed medical reporting forms. The patient entered identifying information on the form, and the attending hospi-

tal corpsman completed a checklist indicating type of illness (diagnosis), initial or follow-up visit, and disposition. From this information, scores were created for each crew member which indicated the number of initial dispensary visits recorded for that individual in each of five illness categories: respiratory illness, dermal disorders, trauma (injury), genitourinary disorders (including venereal disease), and gastrointestinal disorders (including sea sickness). Into these five categories fell 90% of all initial visits. In order to compare amounts of illness incurred by individuals aboard ships deployed for different lengths of time, illness rates were computed for each crew member in each illness category. These rates were derived by dividing the number of initial visits in each category by the number of days of deployment and multiplying by 1,000. Finally, individual illness rates were aggregated for each division, and division means were computed to provide a division illness score for each category.

Analysis Procedures

An analysis of variance (ANOVA) model was used to evaluate the relationships of physical conditions, personnel composition, and work climate to division illness rates. The ANOVA model was chosen because there was reason to believe that the effects of the different environmental domains or dimensions were not additive (cf. Pugh, Note 4), and the interaction terms in ANOVA provided a test for such effects.

For the analyses each major dimension was divided into three levels to provide a sufficient number of levels to detect interactions while limiting the total number of cells in the design. The method used to reduce the number

of division type categories to this tri-level scale was based upon the results of prior illness prediction studies (Rahe, et al., 1972). This previous research indicated that division differences reflecting variations in the type of work and severity of environmental conditions could be represented meaningfully on a 3-level scale. A similar scale, called Physical Job Demands, was developed for the present study and is presented in Table 1. The scale ranged from low physical demands and favorable environmental conditions, such as those for communications and navigation divisions, to high physical demands and severe environmental conditions, such as those for engineering divisions.

Insert Table 1 about here.

In order to trichotomize divisions on the other dimensions, that is, personnel composition and the six work climate scales, cut-off scores corresponding to .44 standard score units above and below the mean for all divisions were determined. The value .44 was chosen because it is the *z* score which corresponds to the cumulative normal probability of .67. Therefore, by scoring each division below, between, or above the two cut-off values obtained for a dimension it could be classified into a low, medium, or high group with each group of roughly equal size. The problem of unequal cell frequencies was resolved by using a dummy variable scoring procedure in a multiple regression analysis (Cohen, 1968).

Data analyses were carried out in two phases in such a way as to implement a hierarchical procedure for accounting for illness variance. In the first phase the more readily available dimensions--physical job demands and

personnel composition--were evaluated using a two-way ANOVA design for each type of illness. In these analyses the amount of illness variance that could be predicted by physical job demands was evaluated first, followed by the amount predicted by the personnel composition measure, and, finally, by the amount predicted by the interaction term. The second phase of the analysis evaluated the work climate dimensions after any illness variance that could be predicted by physical job demands, personnel composition or their interaction had been removed from the criteria. These analyses were designed to assess not only the utility of each work climate dimension, but also the degree that the first and second order interactions of each climate dimension with physical job demands and personnel composition could account for additional illness variance. The sequence in which these terms were evaluated was as follows: (1) the work climate dimension, (2) its interaction with physical job demands, (3) its interaction with personnel composition, and (4) the three-way interaction. This design indicated whether it was necessary to obtain work climate measures in order to account for the maximum predictable variance in the illness measures.

Results

The bivariate distribution of divisions with respect to level of physical demands and personnel composition (quality) is shown in Table 2. The distributions on these dimensions were not independent ($\chi^2 = 47.31$, $p < .01$). Inspection of the cell frequencies indicated that divisions performing more physically demanding work tended to have less able and experienced personnel while divisions performing less physically demanding work tended to have experienced personnel.

Insert Table 2 about here.

Analysis of Illness Data: Phase I

Physical job demands. The first phase of the analysis of the illness data was the evaluation of the illness variance related to physical job demands and personnel composition. The analyses performed were a series of two-way ANOVAs. The results for job demands indicated that this dimension predicted 8.1% of the respiratory illness variance (F [2, 179] = 8.31, $p < .01$), 6.8% of the variance of dermal disorders (F [2, 179] = 7.08, $p < .01$), and 24.8% of the trauma variance (F [2, 179] = 31.22, $p < .01$). The incidence of genitourinary and gastrointestinal disorders were not significantly related to job demands.

Figure 1 shows the rate of each type of illness by level of job demands. Divisions placing the highest physical demands on members, that is, deck and engineering divisions, had the highest illness rates.

Insert Figure 1 about here.

Personnel composition. Differences in illness rates among division types classified by personnel composition were similar to those seen in Figure 1 for job demands but were not statistically significant after those differences associated with job demands had been removed. This result reflects the redundancy between the job demands classification and the personnel composition categories noted in Table 2. Thus, while divisions with personnel manifesting lesser amounts of ability and experience had significantly higher rates of

respiratory illness, dermal disorders, and trauma, these divisions also placed higher physical demands upon their personnel, and no new criterion variance was predicted by adding the personnel composition variable to physical job demands.

Job demands--personnel composition interaction. The interaction between job demands and personnel composition was significant for three types of illness: respiratory illness (F [4, 179] = 2.61, $p < .05$), dermal disorders (F [4, 179] = 3.72, $p < .01$), and genitourinary infectious (F [4, 179] = 2.57, $p < .05$). Thus, even though personnel composition was unrelated to illness once the variance predicted by physical job demands had been accounted for, personnel composition could be used to predict from 5% to 7% more illness variance within levels of job demand. Mean illness rates for the divisions classified by level of job demands and by level of personnel quality are shown in Figure 2. In divisions with high levels of physical job demands, the effects of personnel composition on respiratory illness and dermal disorders differed from the overall trend. Generally, illness rates declined as personnel quality increased, but the opposite was true of the respiratory and dermal illness rates in divisions placing high levels of physical demands on their members. In fact, the highest rates of respiratory and dermal illness were found for divisions that rated high on both physical job demands and personnel composition.

The trend for genitourinary disease was very different from the above. The same divisions that had the highest respiratory and dermal illness rates also had the lowest genitourinary rates.

Insert Figure 2 about here.

Analysis of Illness Data: Phase II

The second phase of analysis was designed to assess the degree that knowledge of organizational-social conditions contributed to the prediction of each type of illness. These analyses assessed not only the individual contribution of each work climate dimension but also the interaction of the work climate measures with the physical job demands and personnel composition dimensions. These analyses were accomplished by a series of three-way ANOVAs using a hierarchical regression technique in which physical job demands, personnel composition, and their interaction were entered into the analysis first. This procedure insured that the F-ratios for terms involving work climate dimensions would not reflect any of the variance accounted for in Phase I of the analyses.

Main effects. These analyses revealed that leadership facilitation and support predicted an additional 3% of the variance in both respiratory illness (F [2, 161] = 3.60, $p < .05$) and genitourinary disorders (F [2, 161] = 3.41, $p < .05$). Divisions with a medium range score on leadership facilitation and support had the lowest incidence of either type of illness.

First-order interactions. Four of the first-order interactions were found to be significant. Three of these involved the personnel composition dimension, including the interaction of (a) personnel composition with leader facilitation and support which affected respiratory illness (F [4, 161] = 2.72, $p < .05$), (b) personnel composition with work group cooperation, friendliness, and warmth which affected trauma (F [4, 161] = 3.54, $p < .01$), and (c) person-

nel composition with professional and organizational esprit which affected gastrointestinal illness ($F\,[4, 161] = 2.54$, $p < .05$). In each case the additional variance accounted for was approximately 5% of the total criterion variance.

The first two interactions are shown in Figures 3 and 4, respectively, and their similarity was striking. The illness rates of divisions with high personnel quality were unrelated to differences in leadership or work group cooperation. Divisions with low personnel quality, however, showed significant variations in respiratory illness and trauma rates, depending upon type of division leadership and work group relations. Both extremes of the leader support and work group cooperation dimensions were associated with higher rates of respiratory illness and trauma in divisions with lower personnel quality while the middle ranges on those dimensions were associated with lower illness rates.

Insert Figures 3 and 4 about here.

The interaction between personnel composition and professional and organizational esprit with respect to gastrointestinal illness was of interest because it was the only term significantly related to gastrointestinal illness. The gastrointestinal illness means for divisions grouped by personnel composition and professional and organizational esprit were inspected to determine which divisions had high or low illness rates. This procedure revealed that divisions with high personnel quality and low esprit had higher gastrointestinal rates than other types of divisions.

The fourth significant first-order interaction was between physical job demands and job standards. The interaction of these two dimensions had a significant effect upon respiratory illness (F [4, 161] = 4.38, $p < .01$). Although this interaction represents over 8% of the respiratory illnesses variance,inspection of the mean respiratory illness rates for the various types of divisions indicated that this interaction was complex and difficult to interpret.

Second-order interactions. Second-order interactions were computed for combinations of physical job demands, personnel composition, and work climate dimensions for each of the illness categories. Three of the 30 possible second-order interactions were significant. Physical job demands and personnel composition interacted with (a) job challenge, importance, and variety to affect respiratory illness (F [8, 161] = 3.79, $p < .01$), and (c) professional and organizational esprit to affect dermal disorders (F [8, 161] = 2.03, $p < .05$). These interactions represent from 7% to 13% of the illness variance; however, such terms are inevitably complex and difficult to interpret; therefore, it is simply noted that predictions of division morbidity rates can be significantly improved by using not only measures of the physical job demands, personnel composition, and work climate separately, but also taking into account particular combinations of these factors to define situations of high or low risk in the shipboard work environments.

Discussion

Each of the three environmental domains used to describe work settings aboard ship, that is, physical job demands, personnel composition, and social

or work climate, provided information relevant to the prediction of illness. Physical job demands as measured by division type accounted for more illness variance than any other single measure. Clearly, personnel working in engineering divisions aboard ship are exposed to increased risk of illness and injury because of the extreme heat, noise, and proximity to dangerous machinery characteristic of their work environments. The situation is confounded, however, by the tendency for less qualified personnel to be assigned to divisions with higher physical demands. Therefore, it was not possible to determine exactly how much of the illness variance was a result of the exposure to physical hazards as opposed to the amount that was a function of the quality of personnel.

An important, and unexpected, finding was that the prediction of morbidity by personnel composition was moderated by the level of physical job demands. In work situations with low or medium levels of physical demands, respiratory illness rate tended to decrease with personnel quality; however, in work situations with high physical demands, the opposite was true--respiratory illness rate increased sharply with the level of personnel quality.

The same trends were evident for dermal disorders. These results run counter to expectations in that generally lower quality personnel tend to have higher illness and injury rates. An explanation for this finding, based primarily upon observations of engineering division personnel aboard ship, appears to be that more able and experienced personnel generally are more involved with their jobs, assume more responsibility, work longer hours, and perform more difficult and demanding tasks than less experienced personnel. Thus, they experience greater exposure to environmental hazards and also more fatigue and

physical strain. For example, especially highly qualified personnel might be assigned to a ship experiencing critical engineering difficulties and might have to work extra hours on hazardous equipment or machinery in order to return it to a safe and ready condition.

The above interpretation also would be consistent with the low genitourinary (VD) illness rate observed for the same divisions. Presumably because of long work hours aboard ship, particularly during port visits, these individuals would have less time ashore and less exposure to VD.

In the second phase of the analysis, illness variance related to division type, personnel composition, and their interaction was removed from the criteria before evaluating the various work climate dimensions, thereby insuring that any additional variance that was predicted was either a function of work climate or a combination of work climate and one or more other predictors. The results showed that leadership facilitation and support was significantly related to respiratory and genitourinary illness and inspection of the mean illness rates at the three levels of the leadership measure revealed a "V" shaped trend for both types of illness. There was a difference in the way that leadership was associated with the two types of illness, however. For divisions with low personnel quality there were large differences in respiratory illness rates among divisions at different levels of the leadership measure, but there were no significant differences in the respiratory illness rate among divisions with high personnel quality. With regard to genitourinary disorders, the "V" shaped trend noted above was manifest for high quality personnel as well as divisions with lower quality personnel.

One factor that might help explain differences in these trends is disease etiology. Exposure to genitourinary disease did not occur on the job aboard ship while exposure to respiratory illness generally was in the work group. With both types of illness the high moribidity rates associated with a lack of leadership is readily understandable; however, the high levels of illness in divisions with high levels of leadership support on the two types of illness deserves attention.

One possible explanation for the apparent effect of leadership on respiratory illness is that highly involved and supportive leaders may create high levels of motivation in their subordinates. When young and inexperienced personnel are highly motivated, they may fail to take adequate measures to protect their health in their zeal to perform, resulting in greater susceptibility to illness. With regard to the genitourinary rates in divisions with different levels of leader support, highly facilitative and supportive leaders may become too close to their personnel and fail to maintain high standards of conduct.

Another interaction of considerable interest was that between personnel composition and work group cooperation, friendliness, and warmth on trauma rate. As with leader support and respiratory illness, the trauma rate in divisions with low quality personnel was related to the work group friendliness and warmth but there were no differences in the trauma rates in divisions with high quality personnel. A medium range of work group friendliness was the optimum level for safety in low personnel quality divisions. This result suggests that accidents and injuries are lowest for young and inexperienced

personnel in divisions where teamwork and a moderately friendly atmosphere are present. A high degree of friendliness and social interaction, however, may lead to "goofing off" and may interfere with safety and discipline.

Analyses of the gastrointestinal illness rate among divisions revealed that all types of divisions tended to have the same rate except divisions with high personnel quality and low esprit. The homogeneity of gastrointestinal rates probably reflects the fact that all segments of the crew are equally at risk during an outbreak of acute gastrointestinal infection. While the high rate observed for divisions with high personnel quality and low esprit may reflect a situation in which able and experienced individuals who are committed to the Navy perceive their work as unimportant, not relevant to the mission of the ship, and not respected by those outside the organization (low esprit). Therefore, it seems plausible that gastrointestinal disorders might be more frequent in this type of work group because of the high conflict and stress that is likely to exist. Further observation is needed to determine if the gastrointestinal disorders occurring in this situation tend to be chronic complaints rather than acute intestinal infections which would lend support to the hypothesis that they were stress-related.

One two-way interaction and three three-way interactions found in the second phase of the analyses remain to be discussed. All represent complex situations that are difficult to interpret. However, the existence of these interactions as well as those discussed previously demonstrates that risk of illness depends upon particular patterns of environmental qualities. Many of these patterns are poorly understood as they relate to the etiology of illness.

Nevertheless, this view that illness risk depends upon a pattern of multiple factors represents a shift in perspective from a single-factor causal approach toward a systems approach where an individual's illness is viewed as a phenomenon to be understood in the context of the environment.

A model which is designed to integrate the present results within a systems perspective is shown in Figure 5. The left-hand portion of the figure lists the three variable domains investigated in the present study which are linked to an overall concept referred to as situational risk. It should be noted that physical hazards, personnel composition, and social or work climate are not to be considered independent sources of situational risk but that their effects are interwoven. Situational risk then affects illness in three ways. First, there is the direct impact of the physical environment on health. For example, one may work with dangerous equipment or in very noisy environments and suffer trauma. Second, the way the work situation is perceived and interpreted may affect health. A detailed model of the psychological processes intervening between environmental stimuli and illness onset has been proposed by Rahe and Arthur (1978). According to this model potentially stressful events impinge upon the individual and depending upon various intervening psychological processes, such as perceptual defenses and coping skills, these events may lead to illness.

Insert Figure 5 about here.

Another way that environmental conditions may affect morbidity rates involves perceptions and evaluations that form the basis of job satisfaction

or dissatisfaction which affects the decision to stay in or leave the situation. The proportion of experienced and trained individuals that leave the work situation because of adverse environmental conditions affects the personnel quality of the remaining work group and thus the illness rate. This set of relationships has been particularly evident for engineering divisions where attrition of experienced personnel has created severe strains and elevated morbidity rates (Gunderson & Hoiberg, 1977).

Based upon the results and model described above, a system, the morbidity forecast model, has been developed to monitor environmental risks aboard U.S. Navy ships (Pugh & Jones, Note 3). Expected illness rates are computed from knowledge of environmental attributes found to be associated with various types of illness. This system can be used to obtain projected or predicted monthly morbidity rates. A research program is under way to apply the system to a new sample of U.S. Navy ships. Although this program is necessarily a time-consuming process because of the quantity of data required to make adequate assessments of shipboard work environments, the results will validate the present results and provide a basis for evaluating the utility of the morbidity forecasting procedure. The present results were based upon assessments by more than 3,000 individuals in 188 divisions, and it is likely that a high degree of stability exists for the relationships obtained.

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Table 1

Level of Physical Job Demands Associated with Division Assignment

Physical Demands of the Work Situation	Types of Division
Low Demands	Electronics
	Intelligence
	Communications
	Navigation
	Administration
Medium Demands	Guns
	Missiles
	Antisubmarine
	Supply
High Demands	Deck
	Boiler
	Machine
	Repair/Auxiliary Repair

Table 2

Frequency Distribution of Divisions by

Level of Job Demands and Personnel Composition[a]

Physical Demands of Job	Personnel Quality: Low	Medium	High
Low	6	24	31
Medium	11	23	26
High	37	25	5

[a]Division N = 188

Illness Rate by Level of Job Demands

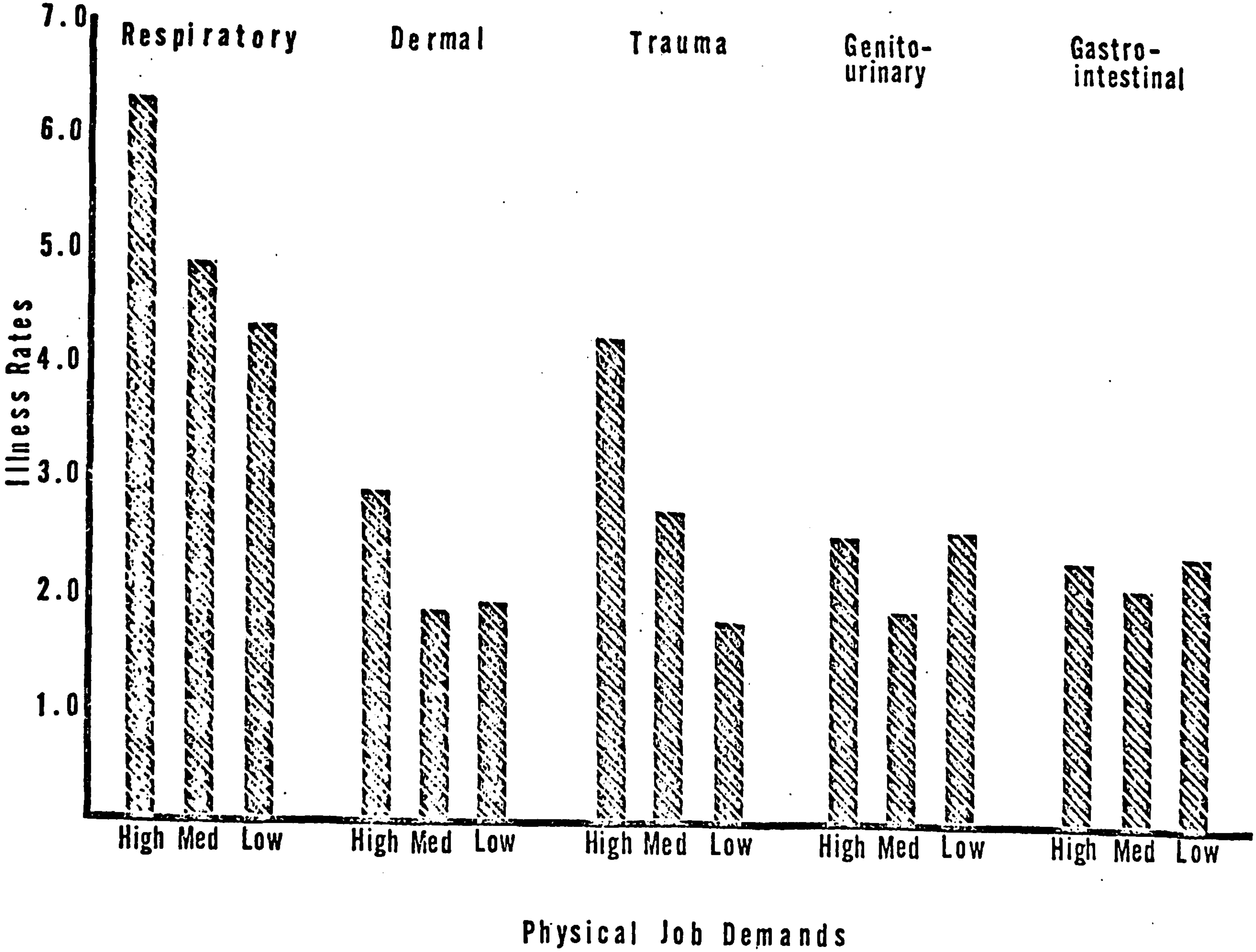
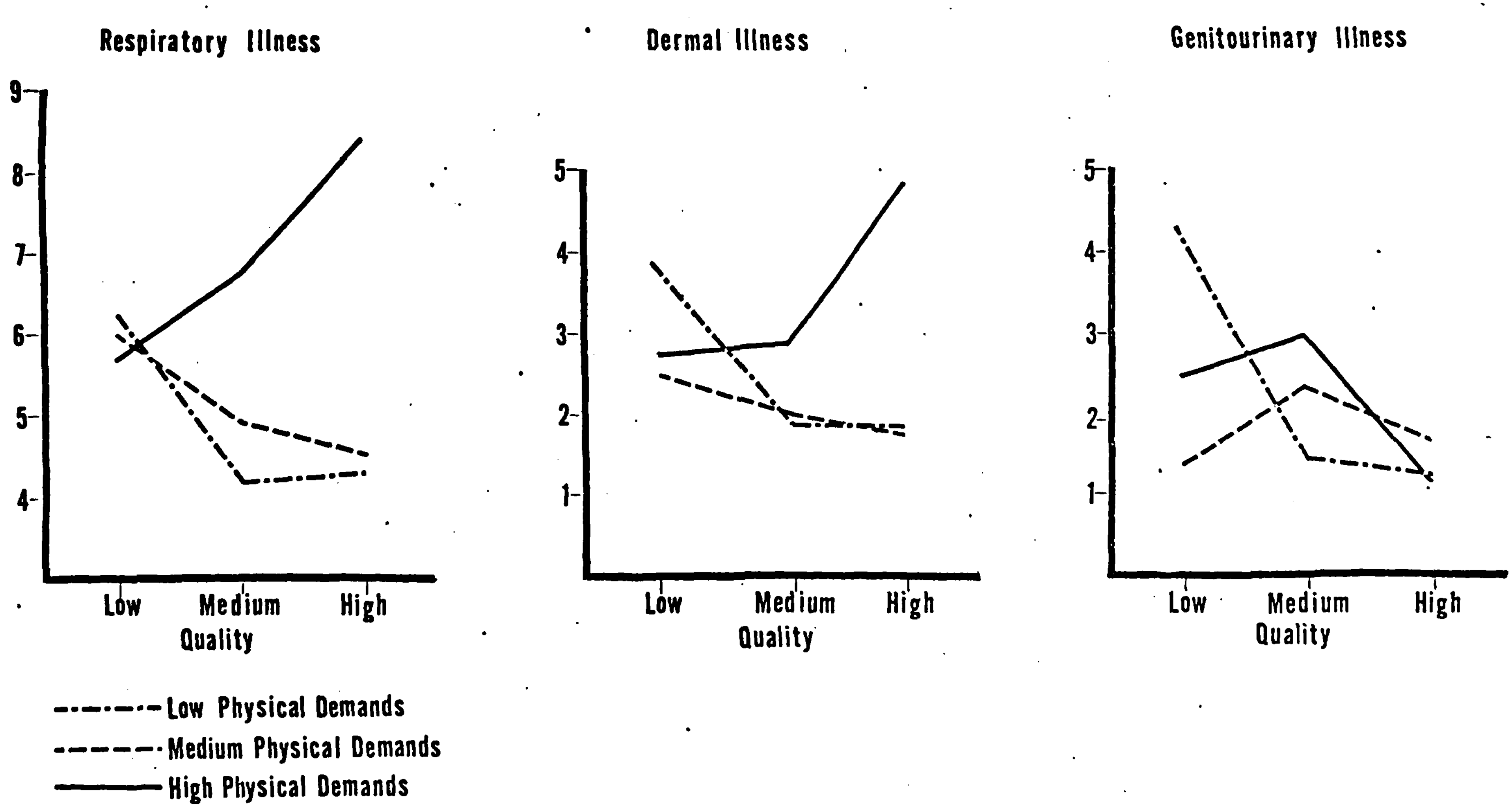


Fig. 1

Illness Rates by Level of Crew Quality and Physical Job Demands



RESPIRATORY ILLNESS RATE BY LEVEL OF

CREW EXPERIENCE AND LEADERSHIP EFFECTIVENESS

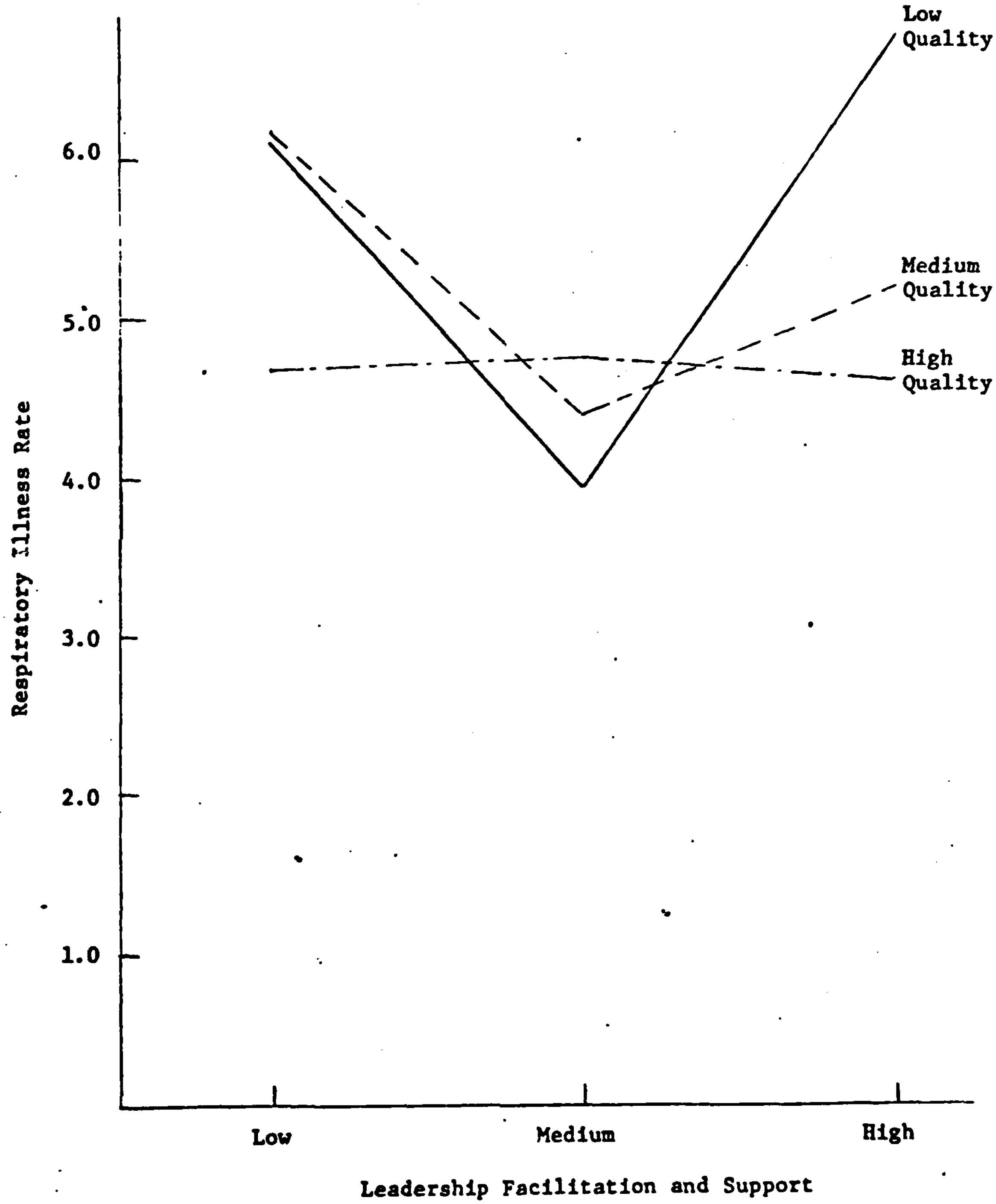
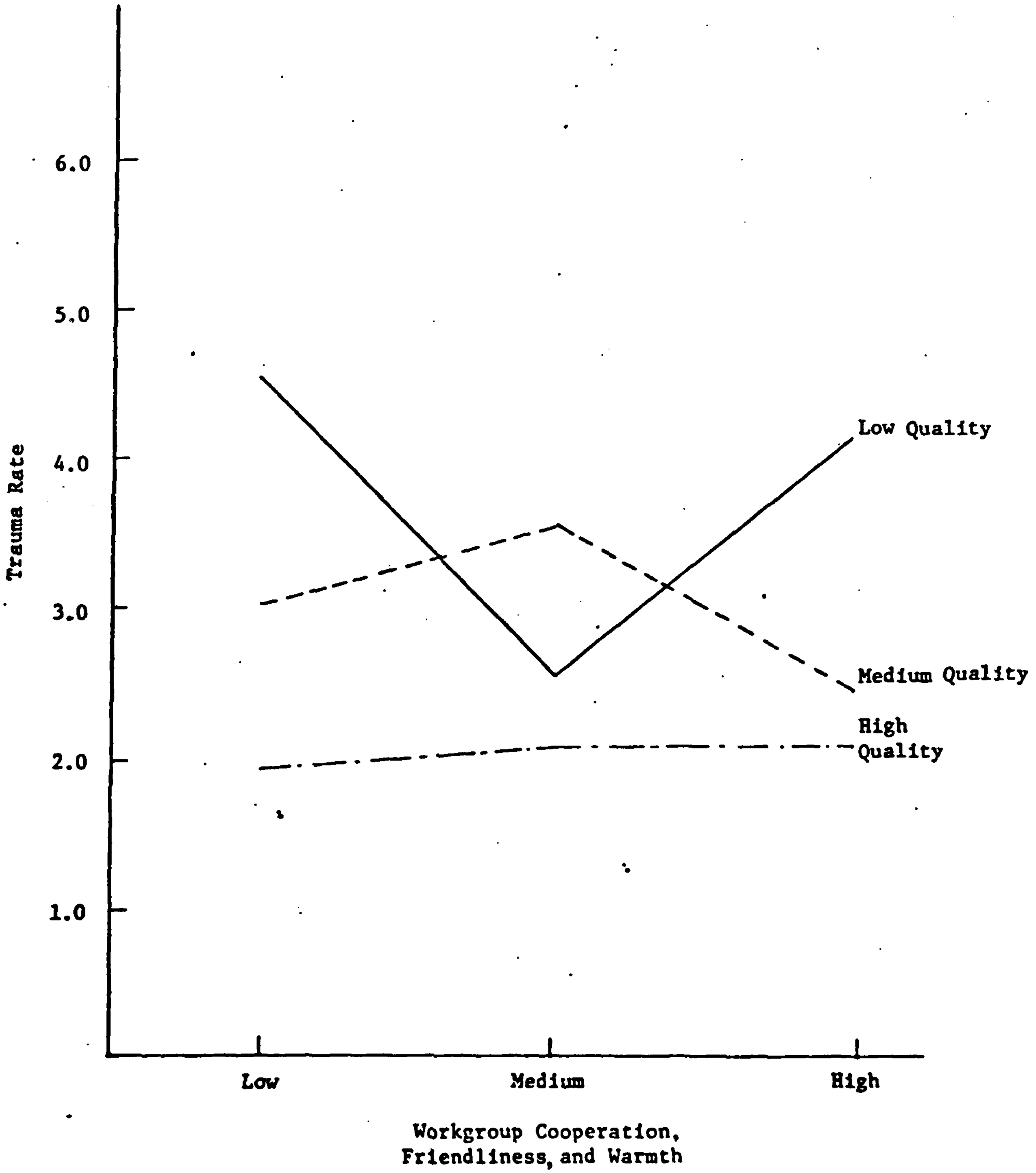


fig 3

TRAUMA RATE BY LEVEL OF CREW EXPERIENCE

AND WORKGROUP COOPERATION, FRIENDLINESS, AND WARMTH



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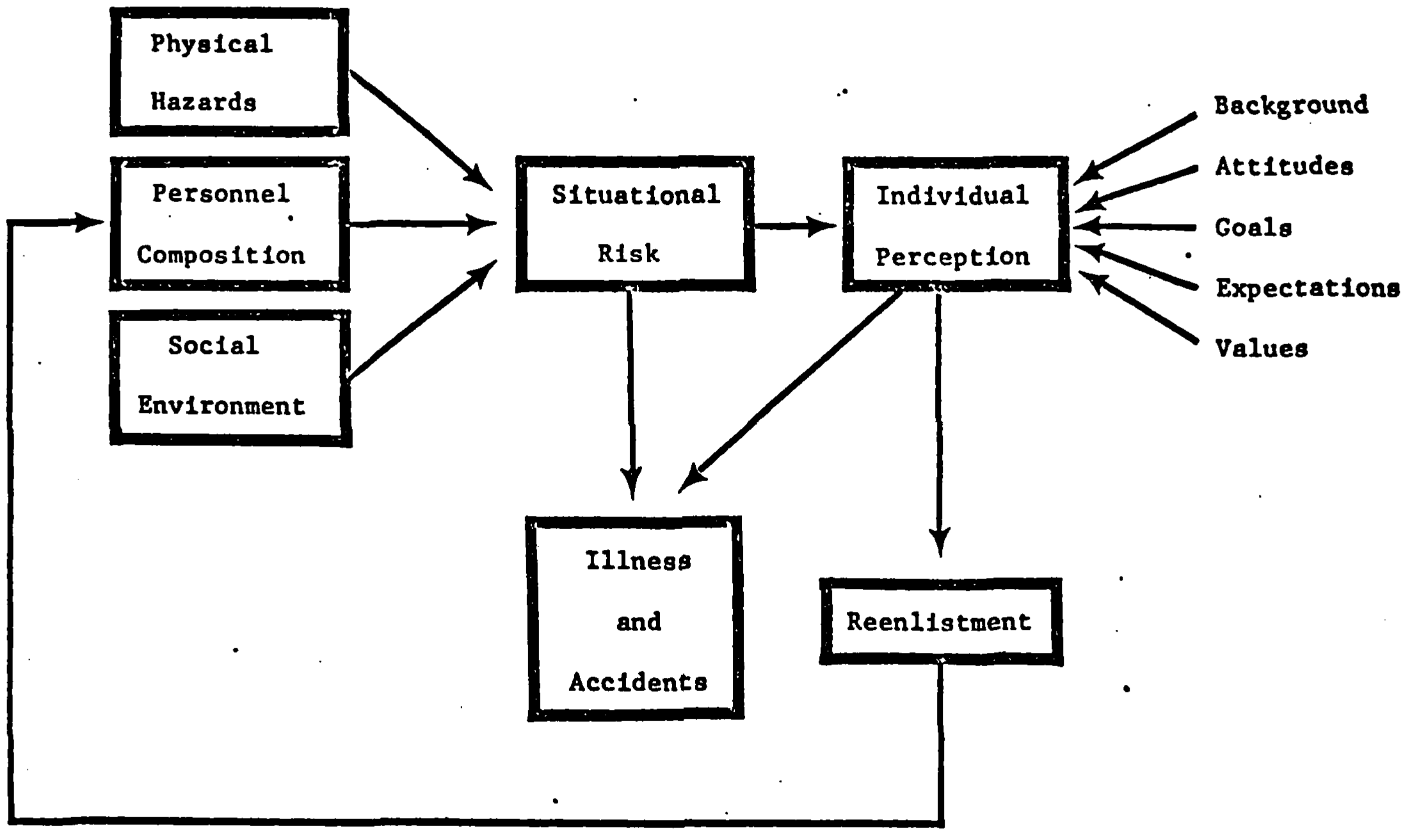
Physical
Hazards
Personnel
Composition
Social
Environment
Situational
Risk
Individual
Perception
Background
Attitudes
Goals
Expectations
Values
Illness
and
Accidents
Reenlistment

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REPORT DOCUMENTATION PAGE

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	6. PERFORMING ORG. REPORT NUMBER
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9. PERFORMING ORGANIZATION NAME AND ADDRESS: Naval Health Research Center, PO Box 85122, San Diego, CA 92138-9174	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: ZF51.524.002-5021.
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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Physical job demands
Personnel composition
Work climate
Morbidity forecasting
Systems approach
Behavior setting
Environmental effects

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Physical job demands, personnel composition, and work climate were assessed for 188 divisions aboard 18 U.S. Navy destroyer-type ships. These measures were used to predict rates of respiratory illness, dermal disorders, trauma, genitourinary illness, and gastrointestinal disorders during routine overseas deployments. A series of analyses of variance indicated that measures from all three of the variable domains contributed significantly to prediction of one or more types of illness. Because the interaction terms were frequently

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significant, it was suggested that a systems approach to the prediction of illness would be useful, and a predictive model based upon this perspective was proposed.

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